The Beginnings of AI in Germany[1]

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The history of AI is a history of fantasies, possibilities, demonstrations, and promise.
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Abstract. The paper describes the historical evolution of Artificial Intelligence as a discipline in Germany in the years upto around 1981. It also describes the cornerstones of the framework of the discipline and how they were installed.

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Introduction

Artificial Intelligence (AI) in Germany suffered from a rather slow start which in comparison to that in the US was delayed by two decades. The establishment of AI as a discipline also met with fierce opposition to some extent hindering the development of its potential. The process has nevertheless turned out a great success.

The present article tells part of this success story in some detail highlighting the main events. Thereby it restricts the focus to the time before, and to the first half decade after, the important year 1975.[3] Since science is nomore a national activity the text relates the events concerning Germany with those of relevance in the rest of the world. The account of these events is provided by someone with a deep involvement in the process rather than by a

historian.[4] In consequence it may be biased to a certain degree although every attempt has been made to avoid such a distorting bias.

The text is structured in two dimensions. After a short characterization of the discipline the story is told as it occurred in time. After this sequential dimension details are given for each of the important cornerstones of the discipline including the main publication and communication medium, the workshops and conferences, the organisational and disciplinary structures, and the educational efforts. All these provided the framework for the healthy growth of a fruitful discipline which already has changed many aspects in our world and still has an even greater potential for a prosperous future of our societies on a habitable globe.

1 Characterization of the Discipline

The ultimate goal of Artificial Intelligence (AI) as a scientific discipline is to understand intelligent behavior in the real world. AI shares this goal with other disciplines such as philosophy, psychology and neural sciences. What distinguished AI from other disciplines with similar ambitions is its research methodology which is based on the computational paradigm.[5] This means that intelligent behavior is assumed to be produced by information processes. In order to discover the nature of these processes AI uses the computer as an experimental tool in order to simulate intelligent behavior in an artificial way and this way create an artificial intelligence, useful also for numerous practical applications.

In order to be able to start such simulations one has first to develop a model of the processes to be simulated. This requires a study of the natural processes be it by self-inspection or by scientific experiments. Such experiments and the resulting models at the cognitive level are the domain of Cognitive Science (CogSci). CogSci and AI hence not only share their ultimate goal but even their research methodology, except that CogSci focusses more on the natural intelligence side while AI excels on the artificial one. Since both obviously need to go together it is an unfortunate development that CogSci and AI divorced around 1980 after a happy and fruitful period of marriage. In order to emphasize the scientific necessity for close collaboration as well as for other reasons the author has proposed the term *Intellectics* as a name for the discipline comprising both AI and CogSci.[6]

2 Early Birds

The history of Intellectics has not yet been written and this is certainly not the place to develop it in all detail. However it is worthwhile to mention several important names of scholars from the German cultural sphere who deserve acknowledgement in our present context.

The universal mind of Gottfried Wilhelm Leibniz (1646–1716) has already had a clear picture of an artificial intelligence and how it could be realized which undoubtedly influenced the later developments in a substantial way. For instance, Gottlob Frege (1848–1925) explicitly referred to Leibniz when he presented his predicate calculus as a universal language for formalizing human thought.[7] Apart from Frege the strong logic school in the German speaking countries in general contributed substantially to the foundation of Computer Science and of Intellectics.

Frege's contemporary Herrmann von Helmholtz (1821–1894) studied and analyzed cognitive functions from a physicist's and physiologist's point of view. Another important influence came from the German school of cognitive (especially Gestalt) psychologists with names such as Otto Selz (1881–1943), Max Wertheimer (1880–1943), Wolfgang Köhler

(1887–1967), Kurt Koffka (1886–1941) and Karl Duncker (1903–1940) many of whom had to leave Germany.[8]

The first German thinker and engineer who based the part of his work with a genuine AI flavor explicitly on the computational paradigm was Konrad Zuse (1910–1995), the inventor of the first universal computer. His *Plankalkül*, the worldwide first universal programming language, can with full justification be called the first AI programming language. Its development was completed to a certain degree in 1945 and used for coding the first chess program in history which however in lack of an implementation of the Plankalkül was never run on a real machine.[9] Today Claude Shannon is usually credited for having developed the first chess program simply because he could run his program and publish the results,[10] two requirements which were unthinkable to be fulfilled in the defeated postwar Germany of the late forties as anyone with personal experiences of these miserable years knows all too well. So Zuse's contributions to AI had no direct impact on AI's development and therefore have remained unrecognized until this day.[11]

These postwar circumstances along with the exodus of a substantial part of the German intelligentzia (like the cognitive psychologists mentioned above) caused by Hitler's dreadful rulings are also the reasons why in the German hemisphere something like the famous Dartmouth Conference in 1956 was unthinkable in the fifties of the last century notwithstanding a number of individual researchers pondering upon ideas of an AI-kind. Many of these gathered around the promising ideas of cybernetics from Norbert Wiener[12] as kind of a "Dachwissenschaft" (ie. a common roof).

The most prominent among them was Karl Steinbuch (1917–2005) who developed the worldwide first neural net, the "Lernmatrix" for which he received patents already in the mid-fifties. The Lernmatrix did not suffer from the problems for which much later the perceptron concept of neural nets was blamed by Minsky and Papert[13] (stopping research in neural nets for quite a while). Like Zuse, Karl Steinbuch envisioned the modelling of intelligent functions such as learning, pattern and "Gestalt" recognition by digital computers. But again his work had no impact on AI's development and until this day is not recognized within the AI community. In 1957 he also invented "Informatik", the German term for Computer Science,[14] by which – in contrast to the later Informatik establishment – he understood information processing *including* the kind familiar in AI. Even a year before Gordon Moore's first statement of what today is called Moore's Law[15] Steinbuch published similar logarithmic plots of the evolution of processor speed and memory capacity.[16]

As an example for some AI stuff under the cybernetics label, the anthology "Kybernetische Maschinen" published in 1964[17] covers a wide spectrum of topics which could as well have been collected in an AI volume of that time had AI existed in Germany as a discipline then. They include language translation, language generation, learning automata, computer aided instruction, law, medicine, and even topics like "elektronisches Gehirn" (electronic brain) or consciousness[18]. None of these topics received enough support to get off ground although to some extent this cybernetics tradition has continued until this day within the disciplines of Nachrichten- (communications), Regelungs- (control), Elektro- (electrical), and Systemtechnik (systems engineering) in parallel with and independent of the German AI community thus wasting efforts for lack of synergetic cooperation. The recovering and traditionally strong engineering disciplines such as mechanical engineering had little interest to allow the rise of a new discipline covering these directions of thinking. Also the cybernetics paradigm was too restricted to serve as a common roof for the interests beyond engineering. Therefore, those who really understood the great potential of the computational paradigm like Zuse and Steinbuch remained isolated exactly for that reason. It is telling that on the basis of this experience Steinbuch decided to go public with a series of bestseller books[19] in which he pointed out the failures of the German technological evolution and

clearly foresaw the growing gap between the US and Germany in this respect and its consequences. His success in the media isolated him even further within the arrogant German academic world of those days.

It is obvious from these events that the German engineering disciplines refrained from playing host to this newly emerging discipline. This explains why those interested in AI eventually hooked up with the *Informatik* discipline which emerged around the universities' growing computing centres in the sixties mostly within, and with substantial influx especially from, (numerical) mathematics. Disastrous experiences in companies like IBM Germany with larger programming projects led to the recognition of the necessity of a discipline which would educate students in the art of programming. The German secretary for research and technology (BMFT) in 1969 set up a committee headed by Robert Piloty to supervise a funding scheme under the name "Überregionales Forschungsprogramm" (ÜRF) for establishing a new discipline named with Steinbuch's term *Informatik*. The money involved was ample incentive for major universities to establish the necessary infrastructure despite considerable resistance from the engineering disciplines.

In 1969 also the *Gesellschaft für Informatik* (GI) was founded and structured in several committees called "Fachausschüsse" (FA). One of those was FA6 "Digitale Verarbeitung kontinuierlicher Signale" (digital processing of continuous signals), established in 1970. In 1971 Hans-Hellmut Nagel joined Theodor Einsele and Wolfgang K. Giloi as a member of FA6 and took the initiative in it. For instance, in 1973 he organized a conference on "Cognitive Methods and Systems".[20] He should play a prominent role for AI in the years to come as we will see in Section 3.

2.1 The parallel evolution in the DDR

This short review of persons and events in the fifties and sixties sofar was restricted to the Bundesrepublik Deutschland (BRD). However, at that time Germany was split into two parts so that there was also the Deutsche Demokratische Republik (DDR) with its own scientific establishment. Like in the BRD there were also several researchers in the DDR interested in AI in that period of time. They were mainly concentrated in two groups, one in Berlin, the other in Dresden.

The leading Informatics figure in the DDR was Nikolaus Joachim – better known as N.J. – Lehmann (1921–1998). Due to his dominance in this field the Akademie der Wissenschaften der DDR, located in Berlin, established the *Institut für Maschinelle Rechentechnik bei der Akademie der Wissenschaften* in Dresden around 1964 which for a couple of years he led as director. The institute lost its status within the Akademie and in 1969 was integrated within the industrial complex called *Kombinat Robotron*. A section in the Robotron, namely the Hauptabteilung E1 (E for "Entwicklung"), evolved from the Akademie-Institut and kept focussing on basic research and theory. Some of its members did interesting work in AI beginning already in 1965 when Egbert Lehmann joined the institute working first on problem solving and, beginning around 1971, on natural language question answering (including knowledge representation and inference). Over the years he built an AI group of around eight researchers which later included Herrmann Helbig working on formula manipulation and Herbert Stoyan who in 1970 implemented the AI programming language LISP. In 1975 Helbig took over the leadership of the group.

In 1969 the Akademie established the *Zentralinstitut für Kybernetik und Informationsprozesse der Akademie der Wissenschaften* (ZKI) in Berlin. This ZKI was structured into four main sections one of which, the "Bereich für Kognitive Psychologie", in the years 1970–1973 was directed by Friedhart Klix, an internationally known cognitive psychologist. This section around 1975 was renamed "Künstliche Intelligenz", consisting of

about 30 researchers and partitioned into four subsections (Abteilungen) covering the areas problem solving, question answering, learning systems, and pattern recognition. Members of this group were eg. Ulrich Geske working on deduction and later on logic programming, Dietrich Koch (natural language processing), and Fritz Wysotzki leading the subsection on classification and pattern recognition. In 1975 Egbert Lehmann from Dresden joined and became leader of the subsection on question answering.

The members of these two major groups in Dresden and Berlin along with others occasionally met in workshops ("Herbstschule") and thereby exchanged their results. Selected members were allowed to travel abroad such as to IJCAI-75 in Tbilisi in the USSR (now Georgia) but also into western countries. Although selected presentations of the Herbstschulen were occasionally published in the series "Kybernetik-Forschung" of the VEB Deutscher Verlag der Wissenschaften in Berlin (eg. vol. 5 of the series in 1975), the publication culture developed rather slowly so that the AI work carried out in the DDR had little or no impact on the development in western Germany and beyond, even in later years. Moreover, several leading figures like Lehmann and Stoyan "managed" to leave the DDR through a "procedure" involving imprisonment of upto a year.

An analog to the GI, the GIDDR, was not founded until 1985. It featured a "Fachsektion" Künstliche Intelligenz from the very beginning, led by Fritz Wysotzki with subsections on natural language processing, expert systems, AI languages, vision, and cognitive systems. By that time several productive researchers had joined the AI community which are visible to this day like Hans-Dieter Burkhard, Heinrich Herre, Klaus-Peter Jantke and many others.[21]

3 Formation of a Community

In 1974 the author received a letter dated 14 November from Gerd Veenker. It contained an invitation to participate in a planned meeting of all German AI groups in Bonn.[22] The meeting eventually took place 18 February 1975 and marked the beginning of the institutionalization of AI in Germany. As the reaction demonstrated such a formation as a community was overdue at that time.

Apart from the 1973 conference mentioned at the end of the previous section there have been several meetings in various Informatik contexts before 1975 featuring AI presentations. For instance, the present author took part in a meeting at the Chiemsee in 1969, probably the first meeting of AI (and other) people within Informatik which were funded by DFG or the 1. Datenverarbeitungsprogramm of the federal government, and met Gerd Veenker (then Tübingen) among others for the first time there. He also presented a talk about his first complete theorem prover (written in Snobol) to the GI Jahrestagung 1971 in München causing a lively discussion on natural deduction vs. resolution approaches in theorem proving. Also German AI researchers presented papers and met at the occasion of international conferences like IFIP-71 in Lubljana, IFIP-74 in Stockholm (featuring remarkable AI contributions like Bob Kowalski's memorable talk on Logic Programming and the first international computer chess competition won by Kaissa, a program from the USSR), and the 2nd Annual Computer Science Conference of ACM in Detroit also in 1974 (while I am not aware of any German participating in or contributing to any of the first three IJCAIs). Some of these researchers gathered experiences by working or studying abroad including Bibel (Wayne State University), Richter (University of Texas at Austin) and Siekmann (Sussex University).

The Bonn meeting then brought all these people together under the explicit label of Künstliche Intelligenz. Apart from the scientific presentations the group had a lively discussion on organisational topics. The hottest issue was the question whether to integrate as a community under the GI umbrella or rather to go along with the German chapter of ACM

(with Joachim Laubsch as strongest advocator). This discussion reflected the beginning of deplorable frictions within the German Informatik because of the dominating emphasis on computing and programming aspects along with negative opinions of AI due not least to the infamous Lighthill report in the UK.

The decision pro GI was taken to a substantial part thanks to Hans-Hellmut Nagel, the only full professor present, who offered his service to the AI community in his influential capacity as Chair of FA6 with the goal to establish a formal GI-Fachgruppe for AI under FA6 and extend the FA6 by new members from AI. The Präsidium of the GI which the present author approached in this matter already in a letter dated 23 January 1975 approved these requests in its meeting of 11 July 1975. Nagel also volunteered to edit a newsletter called "Rundbrief" which should have a deep impact on the community in the years to come. The Bonn meeting also initialized a series of many future German AI conferences. So altogether it can arguably be regarded as the best representative for the institutionalization of the German AI which is discussed in detail in the next section.

4 Institutional Cornerstones of German Intellectics

Any discipline is built on a number of institutional cornerstones which support the collaboration of its members and symbolize its identity. In the present section we will discuss those which are of particular relevance for Intellectics in Germany. As stated in the Introduction our focus will be on the phase of about half a decade after the Bonn meeting in 1975 discussed in the previous section.

4.1 Rundbrief KI

The single most important cornerstone of the German Intellectics community is the "Rundbrief KI", or "Rundbrief der Fachgruppe Künstliche Intelligenz in der Gesellschaft für Informatik" (ISSN 0721-5150), which today, already in its 21st year, is a respected journal simply called "KI" (ISSN 0933-1875). It has appeared four times a year from its beginning, growing rapidly from initially 4 to a level of about 100 pages per issue. As already mentioned Hans-Hellmut Nagel edited the first issues and introduced by example the policy to hand the editorship over to someone else after some time, which led to the involvement of many groups in Germany in this important and influential medium. For the record, he edited 6, Wolfgang Bibel 8, Peter Raulefs 4, Peter Schefe, Harald Boley, Wolfgang Wahlster 9 issues, and so forth. Each new editor added novel features leading to a rapid improvement of the newsletter's overall quality. The first 24 issues were distributed for free to the recipients whose number grew rapidly to over 400 in this period.

Through the Rundbrief the community learned about the identity of other AI researchers and the nature of their work, about workshops and conferences, organisationals decisions and other events. It also provided a podium for debates and for presenting research results. The contents of the Rundbrief offer a rich and highly recommendable source of historical information about the beginnings of AI in Germany and beyond.

In an international context it was not the first of its kind since the AISB and SIGART newsletters offered similar services in Britain and in the US, respectively. An attempt to integrate a separate newsletter for the pattern recognition community (in issue 26, 1982) proved not successful although the topics covered included some from this area as well as, of course, from CogSci.

A German AI Journal beyond the Rundbrief was never a realistic thought while ideas of a European one were discussed rather early but materialized only after the period covered here. This forced German AI researchers to enter the truly tough competition on the international

level to get papers into major conference proceedings and journals, again contributing to a healthy evolution of the community in terms of scientific quality.

4.2 Workshops and Conferences

In Section 3 we already pointed out the importance of the first KI-meeting in Bonn in 1975. Another one-day meeting, organized by H.-H. Nagel followed already at 7 October the same year in Dortmund, co-located with the GI-Jahrestagung. The third meeting was already organized (by W. Bibel) as a one-week workshop, 7.-11.3.1977, with program committee (chair W. Bibel), call-for-papers etc., held at the Hölterhoff-Böcking-Stiftung in Bad Honnef (beautifully located at the Rhine near Bonn) with 77 participants from eight countries. This set the standard for a series of Workshops, called German Workshop for Artificial Intelligence, or GWAI, which still exists as the KI conference now held annually in different locations mostly within Germany. Again each chair added more features: GWAI-4 (chair P. Raulefs), 19.-23.2.1979 in Bad Honnef, adopted this English name, GWAI-5 (chair J. Siekmann), 26.-30.1.1981 in Bad Honnef, was the first with published proceedings (Springer Verlag); and so forth.[23] It is clear that this conference series is of similar importance in the framework of the German AI community as the Rundbrief.

The KI conference series was by no means the only occasion for gatherings. Already in 1975 W. Bibel organized a one-day seminar (12 September) on Automated Theorem Proving (ATP) held at the TU München with international participation (eg. Larry Henschen from Argonne). In January 1976 a one week international workshop on ATP was organized by Michael M. Richter together with Woody Bledsoe from the University of Texas at Austin in the mathematical research institute at Oberwolfach in the Black Forrest, an event which today is counted as CADE-3 in this series of international conferences on automated deduction. In May of the same year the first logic programming meeting took place in London, organized by Bob Kowalski.

Similarly as the ATP subcommunity within German Intellectics, also the natural language understanding subcommunity identified itself in a Workshop "Dialoge in natürlicher Sprache und Darstellung von Wissen" (dialogs in natural language and representation of knowledge), organized by Joachim Laubsch and held in Freudenstadt in the Black Forrest, 17.-19. March 1976, with more than 50 participants. Detlef Rhenius organized the "Erste Arbeitstagung für Kognitive Psychologie" (first workshop for cognitive psychology), 2.-5.4.1978, in Hamburg with appr. 50 presentations, thus establishing the CogSci part of German Intellectics. The "Deutsche Arbeitsgemeinschaft für Mustererkennung" (German community for pattern recognition, DAGM) was formed and held its "1. Symposium über Bildverarbeitung und Mustererkennung", 11.-13.10.1978, in München.

Particularly important was the first AISB conference held outside of the UK on the initiative of H.-H. Nagel as the combined AISB/KI conference in Hamburg, 18.-20.7.1978. H.-H. Nagel acted as conference chair. It featured more than 80 submitted papers and 180 participants from 15 countries and thus was the first major international conference event in Germany on AI. Although for strange reasons it is not counted in the numbering of the GWAI/KIs, it should definitely be regarded as a member of this series (it is counted as a member of the ECAI series though, as the first in fact – see below Section 4.3). It also can be seen as a test run for hosting IJCAI several years later.

Around 1980 the German Informatik showed first indications of a beginning recognition of the relevance of AI. For instance, Ed Feigenbaum, an outspoken AI researcher, was an invited speaker at the GI-Jahrestagung in Saarbrücken which for the first time also featured a separate section on AI.

Already in Section 3 it was illustrated how important international meetings were for the growth and stability of the AI community, in Germany and elsewhere. Eastern Europe had its first AI meeting 30.6.-4.7.1980 in Smolenice, a remote castle in Slowakia, followed by its successor two years later (18.-22.10.1982) at the same place, by the IFAC Symposium on Artificial Intelligence, Leningrad, USSR, October 1983, the new AIMSA series which started in September 1984, and the MMSSSS'85 at Scharmützelsee, April 1985, in the DDR. West-European AI researchers like the present author played important and various formal roles in those events which, along with countless other contacts, events and the resulting information flow enabled by technology of that time, influenced the processes which eventually led to the dissolution of the Eastern block.

From an international point of view the single most important conferences for AI were the IJCAIs. The author's first submission to IJCAI-71, the second IJCAI, failed to arrive in time because of a postal strike in the UK (for mail from the US). Unfortunately, IJCAIs at that time were under the full control of the US AI community, in effect under that of the program chair's home institution like MIT or Stanford, which had little or no sensibility for cultural differences and for the problems with computing infrastructures and with the lack of command of English in the non-English speaking community. In a panel discussion on IJCAI-77, a conference featuring already 800 participants, W. Bibel and H.-H. Nagel gave an overview of the situation in Germany and tried to sensibilize the American colleagues to these problems. Unfortunately, the result was that IJCAI-79 experienced even more complaints from leading European researchers concerning rejected papers. In a letter dated 9.12.1979 to the General Chair of IJCAI-81, Pat Hayes, the AI members of FA6 requested a fairer structure of the refereeing process, especially adequate international participation. Hayes responded by making the issue the topic of a well attended and memorable panel discussion at IJCAI-81 (with Bibel representing the German AI community), a conference which already had 1100 participants. Arguably these efforts had a considerable influence on future IJCAIs.

4.3 Organisational Structures

As already described in Section 3, AI was formed as a GI-Fachgruppe represented in the GI organization by FA6 chaired by H.-H. Nagel, an active AI researcher with an international reputation in vision. Since all other members of FA6 were pattern-recognition representatives,[24] the FA6 was extended in 1975 through a democratic process, first by Joachim Laubsch and Gerd Veenker, and then by Wolfgang Bibel. What happened according to our recollections is that actually two FA6s (in the form of Unterausschüsse) were created, one for pattern-recognition and one for AI. This solution was to a large part due to the diplomatic skills of Nagel and was formally established in 1977. In order to reflect the extended character of the FA6, the GI-Präsidium also agreed to rename the FA6 into "Kognitive Systeme". From now on the AI-section was responsible for running the AI-workshops, representing AI within the GI, caring about the Rundbrief, and for all other business.

In 1977 Nagel stepped back from chairing the FA6 and Peter Deussen took over the chair for the AI-part which was called "Unterausschuß Künstliche Intelligenz des FA für kognitive Systeme". Similarly for Laubsch and Veenker in 1979 who were replaced then by Jörgen Foith, Jörg Siekmann and Wolfgang Wahlster, while Peter Raulefs took over the chair from Deussen who like Bibel stayed on as members. The resulting group signed responsible for the important events ahead.

1976 may be seen as the year when AI people in all of Europe started to get aware of each other and became international actors. In letters of March in that year the author exchanged first ideas about a European AI society with Gérard Huet. In a farsighted letter of 6 May Nagel envisioned IJCAI-79 to take place in Germany. With such a goal in mind Bibel

and Deussen attended the advisory board meeting of IJCAI in 1977 making a bid for hosting IJCAI-79 which failed first by a draw and then by a narrow margin of 2 votes against Japan. Japan's advantage was their AI-related national research program which ended in 1979. But this decision put Germany on top as the next candidate for a non-American IJCAI in 1983. Bibel stayed on as a member of IJCAI's advisory board for many years to come.

At the end of 1979 W. Bibel wrote a letter to major AI figures within Europe arguing for the foundation of a European AI society. This idea met with fierce opposition from AISB, the Society for Artificial Intelligence and Simulation of Behaviour, which already was founded in the UK in 1964 (notably more than a decade before the analog events in Germany). The AISB people argued that AISB was meant as an international society from its beginning and could therefore play exactly such a role for Europe. In fact after the AISB/GI conference in 1978, the annual AISB conference in 1980 took place in Amsterdam (2.-5.7.) demonstrating this role. This conference was filled with ample discussions on this issue. There the decision was made pro a separate European AI body since the continental AI researchers could not identify themselves with AISB. Dennis de Champeaux was assigned to coordinate the process of working out the statutes for ECCAI, the European Coordination Committee for Artificial Intelligence, as an umbrella organisation whose members are national AI societies such as AISB, GI (FA6), AFCET, AICA, NVKI, etc. It was also decided to hold the first European Conference for Artificial Intelligence (ECAI) 12.-14.7.1982 at Orsay with Yves Kodratoff as Conference Chair. Given that in 1978 the annual AISB conference was held outside of the UK, namely in Hamburg (see previous subsection), it was later counted as the first in the ECAI series so that along with the AISB conferences in 1979 – 1981 ECAI-82 later was regarded as the actually fifth ECAI.

At this memorable conference then the statutes worked out in the meantime were approved in brown-pack meetings held on the grass. W. Bibel was elected as the first ECCAI Chair, Yves Kodratoff Vice-Chair and Stefano Cerri Secretary. ECCAI initiated the foundation of further national AI societies such as the Austrian ÖGAI (in 1981) including several in the eastern block. It started running the ECAI series of conferences. Further it acted as a lobby for AI at the Commission of the EU, for which purpose a special subcommittee consisting of Luigia Aiello, Jean-Pierre Jouannaud, Peter Raulefs (chair) and Yorik Wilks was established. Bibel and Raulefs became members of the Scientific Council at the Commission.

4.4 Disciplinary Structures and Education

H.-H. Nagel initiated surveys of the work of German AI groups. According to these there were groups working in natural language understanding, automated deduction, AI programming languages (and later AI machines), computer-aided programming and program analysis, expert systems, vision, robotics, and games. There is no quantitative statistics available how strong each of these subcommunities were during those years. In the subsequent period (to be covered elsewhere) some of these were established as formal Fachgruppen within the GI structure.

Again, H.-H. Nagel already in 1975 asked in the first survey for the AI education offered in the various universities in Germany. Unfortunately, AI was rarely integrated in the standard Informatics course of studies, let alone covered in full by a variety of courses on the different AI subjects. A leading Informatics institute like that at the Technical University München tried to avoid even mentioning AI in its eduction altogether and offered literally not a single AI course until the late eighties.[25]

Because of this miserable situation in the educational sector the AI representatives of FA6 decided to do something about it and to offer courses outside the universities in the form of the *Frühjahrsschule für Künstliche Intelligenz*. W. Bibel and J. Siekmann volunteered to

organize the first of this series which still exists in similar form upto this day. It took place 15.-24.3.1982 in Teisendorf in Oberbayern with great success in all respects (eg. with 110 participants). The lecturers were Wolfgang Bibel, Bruno Buchberger, Jörgen Foith, Bernd Neumann, Peter Raulefs, Jörg Siekmann, and Wolfgang Wahlster. The lectures were published in Springer Verlag and represent the first comprehensive AI text in German.[26] It featured a general introduction to AI, expert systems, deduction, computer-aided algorithm design, natural-language processing, vision, and robotics. It is remarkable to note that its preface to a large extent could as well be the preface of a recent publication on "ambient intelligence".

4.5 Funding Schemes, Research Institutions and Industrial Collaborations

Research in Intellectics was done mainly in the universities across the country. Only a single R&D institution, the *Gesellschaft für Mathematik und Datenverarbeitung* (GMD), Birlinghoven, as well as the *Institut für Deutsche Sprache*, Mannheim,[27] showed a limited interest in AI-type research. As already described in Section 2 the Akademie der Wissenschaften der DDR featured a major AI institute. For industry AI was more or less unknown until the early eighties.

Funding of AI research was done mainly through the *Deutsche Forschungsgemeinschaft* (DFG) in the form of financial support for individual researchers on an extremely small scale. An exception was the SFB 100 (Sonderforschungsbereich or special research area) on "Elektronische Sprachforschung" (electronic language research) carried out at the University of Saarbrücken. It started already in 1973, though without explicit reference to AI, and existed for fifteen years. Around 1981 the DFG also established a Schwerpunktprogramm (research focus program) entitled "Modelle und Strukturen bei der Auswertung von Bild- und Sprachsignalen" (models and structures for evaluating visual and auditory signals) coordinated by H.-H. Nagel. The BMFT funded the ÜRF as described in Section 2 which included some more or less hidden AI topics. Altogether there was nothing of the kind of a research programme like the one funded by the Alfred P. Sloan Foundation in the years beginning with 1975 which initiated the CogSci part of Intellectics in the US.

In this sad situation the Fifth Generation Computer Systems Conference, held 19.-22.10.1981 in Tokyo caused something like a shock to the funding agencies across the world. This is because this conference marked the beginning of a ten years research programme of the Japanese with a heavy emphasis on AI. The author was one out of four invited speakers from abroad. The BMFT sent a delegation led by Dr. Marx, an electronics engineer who came to the ministry from the company Telefunken at Konstanz and for whom this entire AI world was something entirely unfamiliar. The Commission of the European Communities in Brussels was also represented by high representatives who were much better informed since at this point in time they had already started to prepare sort of a counterprogramme to be funded by the Commission under the name ESPRIT. This programme starting in 1983 signalled the beginning of AI as a key technology also in Europe, including Germany which in the meantime was more or less well prepared by all the enormous efforts taken under the difficult circumstances described in this report.

5 Conclusions

Germany was a model of scientific excellence until the early 20th century and to some extent still lives from this earlier substance. However it faced enormous problems in coping with the information technology (IT) revolution which started around 1940, not for lack of ingenuity, given that Zuse was actually the first of his kind in the entire world, but for lack of

an academic structure which would be able to adapt to the requirements of the new way of scientific explorations brought about by IT. In consequence Germany experienced a two decades delay in developing the two new disciplines Informatics and Intellectics. This historical article reviewed the period of time during which Intellectics, or rather just AI, was established. CogSci, the other part of Intellectics, except for scattered contributions (like the one from Klix mentioned in Section 2) started again at least two decades after 1975, the year when it set off on a major scale in the US; hence little could be said about the German CogSci within the time frame under consideration here.

What are the actual reasons for these delays? In my view they are deeply rooted in an academic and, more generally, social culture which overemphasizes hierarchical structures and formal representations (including a heavy bureaucracy) instead of competence and goal-drivenness. This culture tends to bear professors and scientists which misunderstand science as a (absolutistic or democratic) power-game rather than a craft where individual and group skills and ingenuity are the most important drivers. This culture made it difficult for computer science to receive the recognition as a scientific discipline in the fifties and sixties since mathematicians and engineers argued that all there is in Informatics is already coped with by their own disciplines (or rather power-domains); even "worse", in lack of any representational infrastructure the new "discipline" missed to feature the "most important" ingrediences to count as a true discipline. Similarly (and ironically), the informaticians after seizing power argued against the intellecticians that the "reasonable" part of Intellectics is already coped with by Informatics while the rest is non-sense anyway. Despite welcome changes the culture to a certain degree is still with us and is holding back Germany upto this day.

In retrospect the evolution of German AI reads very natural, like carefully planned in advance wrt. all its steps. The secret behind this seemingly logical evolution lies probably more (i) in the fact that the installment of AI was actually overdue and (ii) in the fact that a smart group of fully devoted people closely and fairly collaborated (recall the rotation principles), this way avoiding individual mistakes by group corrections. This group thus featured exactly what the traditional academic institutions lacked.[28] In particular it established a dense and flat network of national as well as international connections. Due to the group's success repercussions of the AI evolution could also be felt in those academic institutional structures which already have changed radically in the last two decades though still not enough yet.

In the times of converging sciences and technologies[29] this openess and adaptability of Intellectics is demanded ever more in order to fulfil its great responsibility as one in a converging set of key sciences and technologies in the scientific, technological, environmental, and social development of the coming years.[30]

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Notes

[1] Part of this text was presented at the Symposium "50 Years AI" during the Conference KI-2006 in Bremen.
[2] Also affiliated with the University of British Columbia in Vancouver, Canada.
[3] An article covering the time after this period by Jörg Siekmann is planned to follow.
[4] For a sociological approach see: Petra Ahrweiler, Künstliche Intelligenz-Forschung in Deutschland – Die Etablierung eines Hochtechnologie-Fachs. Waxmann Verlag, Münster (1995).
[5] Through the success of this paradigm the competitive disciplines have already been penetrated by AI's and and generally IT's methodologies in a process today termed "converging sciences and technologies" (see also footnotes 26 and 27).

[6] W. Bibel, "Intellektik" statt "KI" – Ein ernstgemeinter Vorschlag. Rundbrief der Fachgruppe Künstliche Intelligenz in der Gesellschaft für Informatik (ISSN 0721-5150), Nr. 22, 15–16 (Dezember 1980). See also: W. Bibel, Intellectics. In: Encyclopedia of Artificial Intelligence, second edition (S.C. Shapiro, ed.), John Wiley, New York, 705–706 (1992). The arguments for the necessity of a joint venture of AI and CogSci have been emphasized again in: W. Bibel, Research Perspectives for Logic and Deduction. In: Reasoning, Action, and Interaction in AI Theories and Systems – Essays in Honor of Luigia Aiello on the Occasion of Her 60th Birthday (Oliviero Stock and Marco Schaerf, eds.), LNAI, Springer Verlag, Berlin (2006).
[7] Lothar Kreiser, Gottlob Frege – Leben, Werk, Zeit. Meiner Verlag, Heidelberg (2001).
[8] For some details see: Herbert A. Simon, Models of My Life. The MIT Press, Cambridge MA (1996).
[9] Konrad Zuse, Der Computer mein Lebenswerk. verlag moderne industrie, München, 112–118 (1970). Republished as: Springer, Berlin 1993, ISBN 3-540-56292-3 [Enzyklopädie: Zuse, Konrad. DB Sonderband: Wikipedia Frühjahr 2005, S. 504958]. The Plankalkül was fully published only in 1972 and implemented in 1998 and again in 2000.
[10] Claude E. Shannon, Programming a Digital Computer for Playing Chess. Philosophy Magazine, *41*, 356—375 (1950).
[11] While this lack of impact on AI is deplorable but understandable, it is completely incomprehensible why those laying the foundations of the German Informatik did not at all involve Zuse in their activities (like inviting him to participate in the Algol committee) let alone offering him a professorship. In a revealing letter to the author dated 26.5.1982 Zuse suggests that the reasons for this strange behavior can only be given by the "betreffenden Herren" (the gentlemen in charge, referring to people like Bauer, Rutishauser, Samelson a.o.).
[12] Norbert Wiener, Cybernetics or Control and Communication in the Animal and the Machine. MIT Press (1948). [Enzyklopädie: Wiener, Norbert. DB Sonderband: Wikipedia Frühjahr 2005, S. 490656]
[13] M. Minsky and S. Papert, Perceptrons. MIT Press (1972).
[14] Karl Steinbuch, Informatik: Automatische Informationsverarbeitung (1957).
[15] Gordon E. Moore, Cramming more components onto integrated circuits. Electronics 38(8), 114—117 (1965).
[16] Karl Steinbuch, Können und sollen menschliche Funktionen bei der Raumfahrt von Automaten übernommen werden? See p.294 in: Helmar Frank, Kybernetische Maschinen – Prinzip und Anwendung der automatischen Nachrichtenverarbeitung. S. Fischer Verlag, Frankfurt (1964).
[17] Helmar Frank, Kybernetische Maschinen – Prinzip und Anwendung der automatischen Nachrichtenverarbeitung. S. Fischer Verlag, Frankfurt (1964).
[18] G. Günther, Das Bewußtsein der Maschinen. Agis, Baden-Baden (1957).
[19] Examples are: Karl Steinbuch, Falsch programmiert – Über das Versagen unserer Gesellschaft in der Gegenwart und vor der Zukunft und was eigentlich geschehen müßte. (1968).
Karl Steinbuch, Programm 2000. (1969).
[20] Th. Einsele, W. Giloi und H.-H. Nagel (Hrsg.), Cognitive Verfahren und Systeme. Tagungsband NTG/GI-Fachtagung, 11.–13. April 1973, Hamburg, Lecture Notes in Economics and Mathematical Systems 83, Springer-Verlag Berlin (1973).
[21] A detailed survey of the situation in 1989 is given by Gudula Retz-Schmidt, „Eindrücke einer Vortragsreise in die DDR", KI 1, 29–32 (1990) (http://www.ai.univie.ac.at/archives/mod-ki/0156.html). See also Alfred Kobsa, „KI in der DDR", KI 2, 28–31 (1988) und Hermann Helbig, „KI-Forschung im Kombinat Robotron", KI 4, 74–76 (1992).
[22] The letter read: "Wir beabsichtigen gegen Ende des Wintersemesters (Mitte Februar) hier in Bonn ein Treffen aller auf dem Gebiet der Künstlichen Intelligenz arbeitenden Gruppen durchzuführen. Als Dauer der Tagung sind – je nach Beteiligung – ein bis zwei Tage vorgesehen.
In Übersichtsvorträgen soll die Gruppenarbeit vorgestellt werden bzw. in Kurzreferaten (30 Min. maximal) zu einem Thema gesprochen werden. Sollten Sie die Absicht haben, ein Kurzreferat zu halten, so bitten wir Sie um die Angabe des Titels in Ihrem Antwortschreiben. Die schriftliche Ausarbeitung eines Vortrages wird dann fotokopiert und jedem Teilnehmer zusammen mit den anderen Vorträgen am Ende der Tagung zur Verfügung gestellt.
Wir wären Ihnen sehr verbunden, wenn Sie uns Ihre Teilnahme und eventuelle Bereitschaft, ein Kurzreferat zu halten, schriftlich bis zum 15. 12. 1974 mitteilen würden."
[23] The entire list of these conferences and their proceedings can be accessed at http://www.ki-konferenz.de/older-ki.html.
[24] In 1975 it consisted of Einsele, Kazmierczak, Schürmann, Stief and, of course, Nagel.
[25] While the present author was a member of this department for 18 years he failed to ever receive the necessary teaching credentials (concretely, in 1977 the faculty decided against his passing the Habilitation). In consequence he could not offer any AI course (or any course for that matter) in all the 19 years after receiving the PhD until he emigrated to become full professor at the University of British Columbia and a Fellow of the Canadian Institute for Advanced Research in Canada in 1987. For a considerable period of time in the late seventies the department even denied his DFG-funded project the access to the department's computing

facilities. But due to the support of the then newly hired Professor Eike Jessen and with the help from the university's president Professor Wolfgang Wild he was able to establish a larger research group in the years 1983–1987 funded by DFG and ESPRIT money. This group successfully explored a different model of scientific collaboration with democratic rather than hierarchical features which made it rather autonomous so that it existed more than one and a half decades after the author's leave and produced world-class research results like the proving system SETHEO (winner of the 1994 CASC competition).

[26] W. Bibel, J. Siekmann (eds.). Künstliche Intelligenz. Informatik-Fachberichte 59, Springer Verlag (1982).

[27] The institute developed PLIDIS, the first deductive question answering system for German specialized to the domain of waiste water control; see Forschungsberichte des IDS 42.

[28] Occasionally the group showd signs of overreactions in its tendency to distinguish itself from the academic establishment and its institutional structures. For instance, the natural step of transforming the KI newsletter to a conventional journal met with strong resistence and the proposal of baptizing the field with a proper name (Intellectics) was turned down. These overreactions can only be understood psychologically given that the establishment put intolerable pressures on the AI community.

[29] W. Bibel et al., Converging Technologies and the Natural, Social and Cultural World. Report, European Commission (2004). http://europa.eu.int/comm/research/conferences/2004/ntw/pdf/sig4_en.pdf

[30] Cf: W. Bibel, Lehren vom Leben – Essays über Mensch und Gesellschaft. Deutscher Universitäts-Verlag, Wiesbaden (2003). Also: Stephen Emmott et al., Towards 2020 Science. Microsoft Research Cambridge, (2006). http://research.microsoft.com/towards2020science/